

PATENT SPECIFICATION

NO DRAWINGS

1.068,446

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Date of Application and filing Complete Specification: Jan. 27, 1966.

No. 3825/66.

Application made In Japan (No. 4763) on Jan. 27, 1965.

Application made In Japan (No. 6096) on Feb. 3, 1965.

Complete Specification Published: May 10, 1967.

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Index at acceptance:—A2 BJ3F2

Int. Cl.:—A 23 k 1/16

COMPLETE SPECIFICATION

Feed Compositions

We, TAKEDA CHEMICAL INDUSTRIES, LTD., a Corporation organized under the laws of Japan, of 27, Doshomachi 2-chome, Higashi-ku, Osaka, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a feeding composition for livestock and poultry, and is particularly concerned with a feeding composition containing a 5'-nucleotide, e.g. cytidine 5'-monophosphate, adenosine 5'-monophosphate, guanosine 5'-monophosphate, uridine 5'-monophosphate or inosine 5'-monophosphate (each 5'-nucleotide is hereinafter referred to as "5'-CMP", "5'-AMP", "5'-GMP", "5'-UMP" or "5'-IMP", respectively) or a salt thereof.

One trend in modern nutrition is towards the rapid production of marketable livestock or poultry. Another trend is towards the improvement of the feed efficiency or feed conversion from feed to weight of livestock or poultry.

We have discovered that the inclusion of small amounts of a 5'-nucleotide in livestock or poultry feeds increases the rate of their growth, and improves the feed efficiency or feed conversion from feed to weight of the animal; when the feed composition contains a 5'-nucleotide, the degree of acceptance of the

feed is increased. We have also found that a feed composition consisting of synthetic milk containing a 5'-nucleotide can be used as a remarkably successful milk replacement, for suckling livestock, and that this milk replacement does not cause such undesirable effects as loose bowels or other diseases observed when feeding is done with conventional milk substitutes.

The 5'-nucleotide used in accordance with the present invention may be, for example: 5'-CMP, 5'-AMP, 5'-UMP, 5'-GMP or 5'-IMP or their alkali metal (e.g. sodium or potassium) or alkaline earth metal (e.g. calcium) salt. These compounds can be prepared by conventional methods such as enzymatic treatment, chemical synthesis or hydrolysis of nucleic acid which can be extracted from living tissues (e.g. microorganisms or animal tissues). The compounds may be used independently of, or in combination with, each other and they may be fed in combination with glutamic acid or sodium glutamate, for example. Generally, the amount of 5'-nucleotide added will fall in the range of from 0.001% to 1% by weight, based on the total weight of the feed composition although it may vary with the different 5'-nucleotides, the livestock and poultry which is fed or the stage of feeding. The desirable amount added to a milk substitute is as follows, for example,

5'-nucleotide	Pig		Calf	
	Colostrum (%)	Milk (%)	Colostrum (%)	Milk (%)
5' — A M P	0.002—0.005	0.005—0.01	0.001—0.005	0—0.004
5' — G M P	0.01—0.03	0.01—0.03	0.001—0.002	0.001—0.002
5' — U M P	0.05—0.3	0.03—0.3	0.005—0.15	
5' — C M P			0.005—0.03	0.001—0.003

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The feed to which 5'-nucleotide is added can be any of the feed or nutrient rations commonly fed to livestock, e.g. swine, dairy cattle, beef cattle, calf, lamb, kid, horse, dog and poultry, e.g. chick, layer, breeder, duck, turkey and quail.

These feeds include grains, e.g. corn, wheat, oats, and barley; grain products, e.g. corn gluten feed, wheat middlings, and wheat bran; oil by-products, e.g. soybean meal, cotton seed meal, and linseed meal; forages, both green and dry; e.g. legumes and grasses such as, for instance, alfalfa and clover, and by-products of sugar manufacture, molasses, beet pulp and the like. Mixtures of two or more of these feed ingredients can be present in such combinations that will fulfil the nutrient requirements of the animal. These feeds may contain other sources of protein, fat, minerals and vitamins.

The additive can be incorporated in the feeds in any convenient manner. However, as 5'-nucleotide is easily destroyed by phosphatase which is contained in most feeds, the phosphatase should be inactivated or destroyed just after, or simultaneously with, or before, the addition of the nucleotide fractions to sustain the effect of the 5'-nucleotide. Although the inactivation or destruction of phosphatase may be effected by the addition of a phosphatase inhibitor (e.g. an arsenate, phosphate or cyanate), most of them are unsuitable in an additive for livestock or poultry feed, and the use of a phosphatase inhibitor is therefore desirably avoided. The inactivation is preferably effected by heating for a short time, for example at 60° C. for 40 minutes, at 65° C. for 20 minutes, at 70° C. for 5 minutes, at 75° C. for 4 seconds or at 80° C. for only one second in the case of a milk-type feed. Such a short heating step does not in any significant way affect the natural flavour or taste of the original feeds, and there is also no fear of contamination by an undesirable substance in the product.

Another method of protecting 5'-nucleotide from decomposition with phosphatase is as follows. The 5'-nucleotide is coated with a coating agent which is soluble in water, e.g. polyvinyl alcohol or polyethylene glycol, or by another kind of coating agent which is not decomposed in the presence of water at room temperature but is decomposed at an elevated temperature. The latter coating agent may be, for example, a wax (e.g. ozokerite, ceresin, utah wax or montan wax, paraffin wax, a petrolatum wax, carnauba wax, japan wax, bayberry wax, flax wax, spermaceti, beeswax, chinese wax or shellac, an ester of a fatty acid having from 12 to 31 carbon atoms and a fatty alcohol having from 12 to 31 carbon atoms (e.g. myricyl palmitate, cetyl palmitate, myricyl cerotate, cetyl myristate, ceryl palmitate, ceryl cerotate, myricyl melissate, stearyl palmitate, stearyl myristate, a lauryl laurate, a fatty acid having from 10 to 22 carbon atoms (e.g. decenoic, docosanoic, stearic, palmitic, lauric or myristic acid), a fatty alcohol having from 14 to 31 carbon atoms (e.g. lauryl, cetyl, stearyl, myristyl, myricyl, arachyl, carnaubyl or ceryl alcohol, or the mono-, di- or triglyceryl ester formed from a fatty acid having from 10 to 22 carbon atoms.

The following examples further illustrate the invention but are not intended to limit the invention in any way. In this specification and claims, percentages are all on a weight basis, and, in the examples, "kg", "g", "mg", "IU", "5'-UMP-Na", "5'-CMP-Na", "5'-AMP-Na", "5'-IMP-Na" and "5'-GMP-Na" are respectively "kilogram", "gram", "milligram", "International Units", the "disodium salt of 5'-UMP", the "disodium salt of 5'-CMP", the "disodium salt of 5'-AMP", the "disodium salt of 5'-IMP" and the "disodium salt of 5'-GMP". The temperatures are all uncorrected.

EXPERIMENT 1

Test animals: One-litter size (8 head) of Central Yorkshire pigs, which were divided equally in number into two groups and tested.

Test period: from 60 days old (at weaning) to 180 days old.

Feed used: Control group: Commercial concentration.
Test group: Commercial concentration 99.99 parts
A mixture of 5'-IMP-Na and 5'-GMP-Na (1:1) 0.01 parts

Composition of Commercial Concentration:

forages	27%
rice bran	10%
corn	28%
barley	15%
alfalfa meal	5%
soy bean meal	7%
fish meal	5%
calcium carbonate	1.5%
Sodium chloride	0.5%
Mineral mixture*	0.1%
Vitamin mixture**	0.15%
Aurofac-10***	0.05%
calcium secondary phosphate	0.5%
*mineral mixture contains:	
manganese	24%
zinc	18%
Iron	8%
Copper	1%
Iodine	0.5%
cobalt	0.2%

EXPERIMENT 1 (cont.)

Composition of Commercial Concentration (cont.):

**vitamin mixture contains:

vitamin A	800,000 IU
vitamin D	200,000 „
vitamin E	400 „
vitamin B ₁₂	1.6 mg
riboflavin	800 „
niacin	5,000 „
<i>d</i> -pantothenic acid	1,000 „
choline chloride	70,000 „
menadione	264 „
<i>dl</i> -methionine	68 „
folic acid	60 „
1,2-dihydro-6-ethoxy-2,2,4-trimethyl-quinoline	1.4 „

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Result:

(1) Weight gain

Average body weight per pig (kg)

age of pigs group \	60 day-old (at starting)	90 day-old	120 day-old
Control	14.20	28.64	47.11
Test	13.94	29.96	52.31
	150 day-old	180 day-old	
Control	66.20	81.00	
Test	76.24	95.48	

EXPERIMENT 1 (cont.)

(2) Average gain (Kg)

age of pigs group	60—90 day-old	90—120 day-old	120—150 day-old	150—180
Control	14.44	18.47	19.19	14.80
Test	16.02	22.55	23.93	18.20

(3) Average feed consumed (Kg)

age of pigs group	60—90 day-old	90—120 day-old	120—150 day-old	150—180 day-old
Control	48.37	59.47	82.09	80.36
Test	50.56	69.96	93.81	88.46

(4) Feed conversion

age of pigs group	60—90 day-old	90—120 day-old	120—150 day-old	150—180 day-old
Control	3.35	3.22	4.30	5.43
Test	3.15	3.13	3.90	4.85

(5) Others

The pigs of the control group had loose bowels after several days from the start of the test, while in the test group no such symptom was found.

EXPERIMENT 2

Test animals: 6 sucklings of Yorkshire pigs, which were divided equally in number into two groups and tested.

Test period: from 5 day-old to 60 day-old

Feed used:

group	period	5—19 day-old	20—26 day-old	27—60 day-old
	Control	Colostrum milk A	milk A	milk B
	Test	Colostrum milk A	milk A'	milk B'
			milk A (%)	milk B (%)
	wheat flour		55.8	25.97
	soybean powder (treated at 120° C.)		20	0
	yellow corn		0	35
	soybean powder (raw)		0	15
	fish meal		8.44	6.3
	forages		0	3.5
	molasses		13.3	12
	calcium carbonate		1.25	1.2
	calcium secondary phosphate		0.2	0.2
	mineral mixture*		0.05	0.05
	sodium chloride		0.5	0.5
	Aurofac 10***		0.2	0.12
	vitamin mixture**		0.16	0.16
	protease		0.1	0

*, **, ***, each is the same as Experiment 1.

EXPERIMENT 2 (cont.)

Milk A: Commercial synthetic milk containing more than 25% of crude protein, more than 5% of crude fat, more than 3% of crude fiber and more than 7% of crude ash.

Milk B: Commercial synthetic milk containing more than 21% of crude protein, more than 3% of crude fat, more than 3% of crude fiber and more than 7% of crude ash.

Milk A': synthetic milk consisting of 99.99% of milk A and 0.01% of an equivalent mixture of 5'-IMP-Na, 5'-GMP-Na, 5'-CMP-Na and 5'-UMP-Na.

Milk B': synthetic milk consisting of 99.99% of milk B and 0.01% of an equivalent mixture of 5'-IMP-Na, 5'-GMP-Na, 5'-CMP-Na and 5'-UMP-Na.

Result:

(1) Average body weight per pig (Kg)

age of pigs group	5 day-old	20 day-old	60 day-old
Control	1.63	2.52	8.1
Test	1.62	2.83	60.7

(2) Weight gain (5—60 days)

group	average gain per pig (Kg)	average synthetic milk consumed (Kg)	average feed conversion
Control	6.46	13.24	2.05
Test	9.08	15.61	1.73

EXPERIMENT 3

Test animals: 9 sucklings of Central Yorkshire pigs, which were divided equally in number into three groups and tested.

Test period: from 22 day-old to 60 day-old pigs.

Feed used:

age of pigs group	1—2 days	3—10 days	11—22 days	23—26 days	27—60 days
Control 1	colostrum	colostrum +milk A	milk A	milk A	milk B
Control 2	„	„	milk A + cows milk	„	„
Test	„	colostrum + milk A'	milk A'	milk A'	milk B'

Milks A, A', B and B' are the same as in Experiment 2.

Results:

	Control 1	Control 2	Test
Average initial weight (Kg)	1.47	1.35	1.35
Average weight at 22-day-old (Kg)	3.8	4.2	4.8
Average final weight (Kg)	13.1	14.4	16.7
Average gain per pig in the period of 22—60 day-old (Kg)	0.3	10.2	11.9
Average feed conversion	1.99	1.83	1.81

EXPERIMENT 4

Test animals: 10 calves, which were divided equally in number into two groups and tested.

Test period from 2 to 22 week-old calves.

Feed used:

age of calves	group	Test (g/calf/day)			Control
		milk substitute	calf starter	roughage (hay)	
1—4 days-old			(colostrum)		
5—7	„	500			
8—10	„	750	a little	a little	Total
11—20	„	1000	„	„	
21—30	„	1000	200	200	mother's milk 280 Kg/calf
31—35	„	750	600	300	defatted milk 600 Kg/calf
36—40	„	500	1000	400	
41—45	„	250	1300	500	starter 124 Kg/calf
46—55	„		1500	700	
56—80	„		1700	1000	
81—100	„		2000	1500	
101—110	„		1000	1000	2000
111—150	„			2000	2500
Total (Kg/calf)		31	125	90	
after 150 day-old starter 2000 g/calf /day +hay 3000 g/calf /day					

EXPERIMENT 4 (cont.)

milk substitute:

defatted milk	70%
whey	5%
5'-nucleotide mixture*	10%
glucose	6.5%
lard	5%
mineral mixture**	0.5%
vitamin mixture***	3%
TDN (Total Digestible Nutrients)	88.15%
CP (Crude Protein)	27.25%
DCP (Digestible Crude Protein)	25.65%
Calf-starter:	
Soybean oil meal	15%
linseed meal	10%
corn	20%
oats	20%
forage	20%
5'-nucleotide mixture*	10%
molasses	2%
mineral mixture**	0.5%
vitamin mixture***	2.5%
TDN	69.18%
CP	20.54%
DCP	17.46%

* the 5'-nucleotide mixture contains 0.15% of 5'-CMP-Na, 0.3% of 5'-AMP-Na, 0.26% of 5'-UMP-Na, 0.05% of 5'-IMP-Na and 0.09% of 5'-GMP-Na.

** the mineral mixture contains 24% of manganese, 18% of zinc, 8% of iron, 1% of copper 0.5% of iodine and 0.2% of cobalt.

*** the vitamin mixture contains 800,000 IU of vitamin A, 200,000 IU of vitamin D₃, 400 IU of vitamin E, 1.6 mg of vitamin B₁₂, 800 mg of riboflavin, 5 g of niacin, 1.6 g of pantothenic acid, 70 g of choline chloride, 260 mg of menadione, 70 mg of *DL*-methionine, 60 mg of folic acid, 11 mg of 1,2-dihydro-6-ethoxy-2,2,4-trimethyl-quinoline and 1 g of antibiotic agent in 5 g of the mixtures.

EXPERIMENT 4 (cont.)

Starter: Commercial cattle supplement.

Result

age of calf group	Average body weight per/calf (Kg)	
	16 week-old	22 week-old
Control	113	125
Test	123	147

EXPERIMENT 5

Test animal: Kiiiku No. 1 (broiler chicken)

Test Period: from 1 to 60 day-old

Number of one group: females 30
males 30

Feed used:

Group	Feed Used	
1	basal diet 99.95% + 5'-IMP-Na	0.05%
2	„ + 5'-GMP-Na	„
3	„ + 5'-AMP-Na	„
Control	„	

EXPERIMENT 5 (cont.)

Composition of basal diet

yellow corn	45%
rice bran	4%
forage	4%
soy bean meal	9%
fish meal	6%
fish soluble	3%
alfalfa meal	2%
calcium carbonate	5%
tertiary calcium phosphate $\text{Ca}_3(\text{PO}_4)_2$	0.4%
sodium chloride	0.35%
vitamin mixture**	0.1%
mineral mixture*	0.05%
furazolidone	0.01%

*, **: each is the same as in Experiment 1.

Results:

Group	Initial		Final			
	No. of chicken	Average weight per chicken (g)	No. of chicken	Average weight per chicken (g)	Average feed consumed (g)	Average feed conversion
1	60	74	59	1,305	3,898	3.1
2	60	75	58	1,272	3,738	3.1
3	60	74	59	1,340	3,888	3.0
Control	60	75	55	1,317	4,183	3.3

EXPERIMENT 6

Test animal: White leghorn (chicken breeder)

Test period: from 1 to 30 day-old chicken

Number of one group: males 25

Feed used:

Group	Feed used
Control	basal diet*
1	„ 99.5% + 5'-nucleotide mixtures**0.5%
2	„ 99% + 5'-nucleotide mixture**1%

* the same as in Experiment 5

** 5'-nucleotide mixtures containing 0.15% of 5'-CMP-Na, 0.03% of 5'-AMP-Na, 0.26% of 5'-UMP-Na, 0.05% of 5'-IMP-Na and 0.09% of 5'-GMP-Na.

Results:

age	group	Control	1	2
Initial	average weight per chicken (g)	33	33	33
	average weight per chicken (g)	100	98	95
10 day-old	Total feed used per chicken (g)	188	120	114
	average feed conversion	2.8	1.7	1.7
20 day-old	average weight per chicken (g)	216	208	208
	total feed used per chicken (g)	560	440	440
	average feed conversion	3.0	2.5	2.5
30 day-old	average weight per chicken (g)	364	356	352
	total feed used per chicken (g)	1100	800	860
	average feed conversion	3.3	2.7	2.6
40 day-old	average weight per chicken (g)	548	540	520
	total feed used per chicken (g)	1740	1430	1439
	average feed conversion	3.3	2.8	2.9

The invention is now illustrated by the following Examples:

EXAMPLE 1

Chick pre-starter

Ingredients	g
Corn	1000
Soybean oil meal 44%	600
Alfalfa meal	20
Fish meal (60%)	100
Meat and bone scraps (50%)	50
Condensed fish solubles	60
Dried whey	50
Distillers' dried solubles	50
Phosphate*	20
Ground oyster shell or limestone	30
Salt	10
Manganese sulphate	0.5
"Peckmor" ** poultry feed flavour	1
5'-UMP-Na	0.1
5'-IMP-Na	0.1
5'-CMP-Na	0.1
5'-GMP-Na	0.1
5'-AMP-Na	0.1

* Phosphate containing from 26% to 32% calcium and 18% of phosphorus

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EXAMPLE 2

Chick starter

Ingredients	g
Wheat	600
Corn	600
Soybean oil meal (44%)	560
Alfalfa meal	60
Dried whey	50
Fish meal (60%)	50
Phosphate*	30
Ground oyster shell or limestone	30
Salt	10
Manganese sulphate	0.5
"Peckmor" Poultry Feed Flavour	0.5
5'-IMP-Na	0.1
5'-GMP-Na	0.1
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*, ** the same as the Example 1.

EXAMPLE 3

Broiler starter

Ingredients	g
Corn	1050
Soybean oil meal (50%)	625
Alfalfa meal	50
Poultry by-product meal	50
Dried whey	50
Fat	90
Phosphate*	30
Ground oyster shell or limestone	35
Manganese sulphate	0.5
"Peckmor" ** Poultry Feed Flavour	0.5
5'-IMP-Na	0.1
5'-GMP-Na	0.1
	<hr/> 2000

*, ** the same as the Example 1.

EXAMPLE 4

Broiler finisher

Ingredients	g
Corn	700
Wheat	600
Soybean oil meal (50%)	320
Poultry by-product meal	100
Distillers dried solubles	50
Condensed fish solubles	50
Alfalfa meal	60
Fat	50
Phosphate*	30
Ground oyster or limestone	30
Salt	10
Manganese sulphate	0.5
"Peckmor"** Poultry Feed Flavour	0.5
5'-IMP-Na	0.1
5'-GMP-Na	0.1
	<hr/> 2000

*, ** same as in Example 1.

EXAMPLE 5

Pig milk replacer

Ingredients	starter (g)	Pre-starter (g)
Corn powder	30	10
Wheat powder	28	23
Soybean powder (treated at 120° C.)	25	20
Fish meal	8	5
Molasses	4.5	
5'-Nucleotide mixtures*	0.5	0.5
NaCl	0.3	0.3
Precipitated calcium carbonate	0.4	0.45
Calcium secondary phosphate	0.6	0.7
Aurofac—10**	0.2	0.3
Pepsin	0.1	0.1
Spice for pigs	0.05	0.05
Vitamin B ₁₂ (2.2%)	0.05	0.1
Sodium cyclohexylsulphamate	0.09	0.1
Non-fat milk powder		25
Sugar		7

* 5'-nucleotide mixtures containing 0.15% of 5'-CMP-Na, 0.03% of 5'-AMP-Na, 0.26% of 5'-UMP-Na, 0.05% of 5'-IMP-Na and 0.09% of 5'-GMP-Na.

** Registered Trade Mark of American Cyanamid Co.

EXAMPLE 6

Pig pre-starter

Ingredients	g
Ground yellow corn	435
Sucrose	200
Dried skimmed milk	600
Fish meal (60%)	100
Soybean oil meal (44%)	400
Dried whey	100
Condensed fish solubles	40
Fat	80
Phosphate*	15
Ground oyster shell or limestone	10
Salt, iodized	10
Manganese sulphate	0.25
5'-CMP-Na	0.1
5'-UMP-Na	0.1
Sodium glutamate	1

* the same as in Example 1.

EXAMPLE 7

Sow Feed

Ingredients	g
Corn	1340
Wheat middlings	300
Soybean oil meal (44%)	200
Tankage	60
Alfalfa meal	60
Phosphate	10
Ground oyster shell or limestone	20
Salt	10
Manganese sulphate	0.25
5'-IMP-Na	0.05
5'-GMP-Na	0.05
5'-CMP-Na	0.05
5'-Sodium glutamate	0.5
	<hr/> 2000

EXAMPLE 8

Calf starter

Ingredients	g
Corn	560
Wheat middlings	400
Soybean oil meal (44%)	400
Linseed meal	300
Distillers' dried solubles	50
Alfalfa meal	100
Condensed fish solubles	50
Molasses	100
Ground oyster shell or limestone	30
Salt	10
Manganese sulphate	0.25
Sodium glutamate	0.5
5'-nucleotide mixtures*	3
	<hr/> 2000

* The same as in Example 5.

EXAMPLE 9

Horse and mule feed

<u>Ingredients</u>	<u>g</u>
Corn (Cracked)	700
Oats (Crimped)	800
Linseed meal	100
Alfalfa meal	100
Wheat bran	200
Molasses	100
Manganese sulphate	0.25
5'-nucleotide mixtures*	3
Sodium glutamate	1
	<u>2000</u>

* The same as in Example 1.

EXAMPLE 10.

Duck Grower

Ingredients

	g
Corn	500
Wheat	764
Soybean oil meal (44%)	60
Alfalfa meal	50
wheat middlings	200
Fish meal (60%)	50
Meat and bone scraps (50%)	100
Oats, pulverized	10
Delactosed whey	10
Ground oyster shell or limestone	40
Salt	5.5
Manganese sulphate shell or limestone	0.5
5'-nucleotide mixtures*	5
Sodium glutamate	2
	2000

* The same as in Example 1.

WHAT WE CLAIM IS:—

1. A feed composition for livestock or poultry which contains a 5'-nucleotide.
2. A feed composition as claimed in claim 1 in which the 5'-nucleotide is cytidine 5'-monophosphate or a salt thereof.
3. A feed composition as claimed in claim 1 in which the 5'-nucleotide is adenosine 5'-monophosphate or a salt thereof.
4. A feed composition as claimed in claim 1 in which the 5'-nucleotide is guanosine 5'-monophosphate or a salt thereof.
5. A feed composition as claimed in claim 1 in which the 5'-nucleotide is uridine 5'-monophosphate or a salt thereof.
6. A feed composition as claimed in claim 1 in which the 5'-nucleotide is inosine 5'-monophosphate or a salt thereof.
7. A livestock milk substitute which contains cytidine 5'-monophosphate or a salt thereof.
8. A livestock milk substitute which contains adenosine 5'-monophosphate or a salt thereof.
9. A livestock milk substitute which contains guanosine 5'-monophosphate or a salt thereof.
10. A livestock milk substitute which contains uridine 5'-monophosphate or a salt thereof.
11. A pig milk substitute which contains adenosine 5'-monophosphate or a salt thereof.
12. A pig milk substitute which contains guanosine 5'-monophosphate or a salt thereof.
13. A pig milk substitute which contains uridine 5'-monophosphate or a salt thereof.
14. A feed composition or a livestock or pig milk substitute as claimed in any of claims 1 to 13 which contains from 0.001% to 1% by weight of the 5'-nucleotide.
15. A method of increasing the rate of growth of livestock or poultry in which a

nutrient ration containing an amount of a 5'-nucleotide effective to produce weight gain in the livestock or poultry is fed thereto.

5 16. A method as claimed in claim 15 wherein the 5'-nucleotide is cytosine 5'-monophosphate or a salt thereof.

17. A method as claimed in claim 15 in which the 5'-nucleotide is adenosine 5'-monophosphate and a salt thereof.

10 18. A method as claimed in claim 15, in which the 5'-nucleotide is guanosine 5'-monophosphate or a salt thereof.

15 19. A method as claimed in claim 15, in which the 5'-nucleotide is uridine 5'-monophosphate or a salt thereof.

20. A method as claimed in any of claims 15 to 19 in which the 5'-nucleotide is fed to suckling livestock.

21. A method of improving the feed conversion of livestock or poultry in which a nutrient ration containing an amount of a 5'-nucleotide effective to increase the feed conversion of the livestock or poultry is fed thereto. 20

22. A method as claimed in claim 21, wherein the 5'-nucleotide is guanosine 5'-monophosphate or a salt thereof. 25

23. A method as claimed in claim 21, wherein the 5'-nucleotide is inosine 5'-monophosphate or a salt thereof. 30

24. Livestock or poultry when fed by a method as claimed in any claims 15 to 23.

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Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.
—1967. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2.
from which copies may be obtained.